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EFFECT OF DEAERATION ON THE FLAVOR STABILITY OF CONCENTRATED SWEETENED CREAM

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SUMMARY

Adequate deaeration markedly lessened flavor deterioration in concentrated sweetened cream during storage for 6 mo. at 40 and 70° F. The effectiveness of deaeration increased as the temperature at which it was initiated was increased from 135 to 170° F. and as the period of deaeration was lengthened from 0 to 60 min. On the other hand, addition of oxygen to concentrated sweetened cream accelerated the rate of flavor deterioration. The peroxide values of deaerated samples decreased slightly during storage, whereas those of nondeaerated samples increased greatly.

Concentrated sweetened cream (1, 6) contains approximately 40% fat. As with other milk products, the development of off-flavors such as stale, oxidized, and rancid, must be guarded against. A sucrose content of 60-65% in the water portion furnishes the necessary protection from quality-damaging bacteria when high-quality cream is used and adequate sanitation is maintained.

The purpose of this work was to investigate the efficacy of removing oxygen by deaeration in maintaining the flavor of this product.

The equipment used for preparing the samples was pilot-plant scale.

Preparation of concentrated sweetened cream. Whole milk was pasteurized at 170° F. for 15 sec. or at 150° F. for 30 min., separated, and the cream standardized to 65% fat. The cream was warmed to 130-140° F. and sucrose and nonfat dry milk (NFDM) were added at the rate of 52 and 10 lb., respectively, per 100 lb. of 65% cream. Thus, each 162 lb. of the final product, concentrated sweetened cream, contained approximately: 65 lb., or 40% of milk fat; 52 lb., or 32% of sucrose (62% in the sucrose-water portion); 13 lb. or 8% of nonfat milk solids (3 lb. from the cream and 10 lb. added); and 32 lb., or 20% of water.

This blend of heavy cream, sucrose, and NFDM was heated in some experiments (Figures 1, 2, and 3) for 15 sec. at 170° F. and tempered immediately as required in a continuous (tubular) operation, before it was deaerated as described below; in others (Figure 4 and 5) it was heated to 150° F., deaerated, and then given a final heat treatment at 150° F. for 30 min. in small hermetically sealed cans to insure the prevention of growth of molds (4) and other undesirable organisms.

Deaeration. Batches of concentrated sweetened cream were divided into two parts. One part was the control, the other was deaerated, except as noted, by flashing it into an unheated vacuum pan at a temperature within the range of 135 to 170° F. with the vacuum at approximately 29 in. of mercury, holding it momentarily, breaking the vacuum, and sampling and then holding under the vacuum for 30 min., again sampling and again deaerating for 30 min. At the

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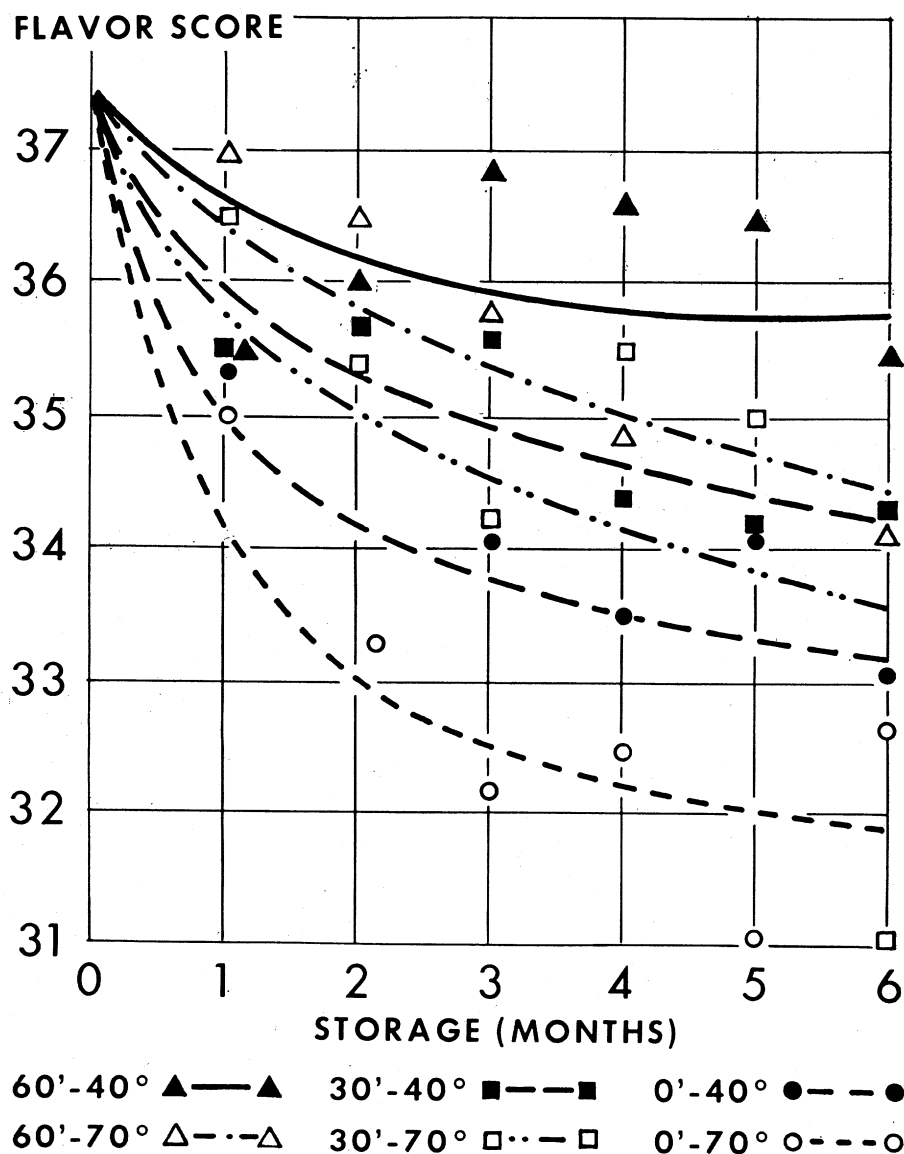


FIG. 1. Effect of deaerating and vacuum-packing concentrated sweetened cream on its flavor score during storage at 40 and 70° F., when the temperature of the concentrate pumped to the unheated vacuum pan was 135° F. and the holding time was 0, 30, and 60 min.

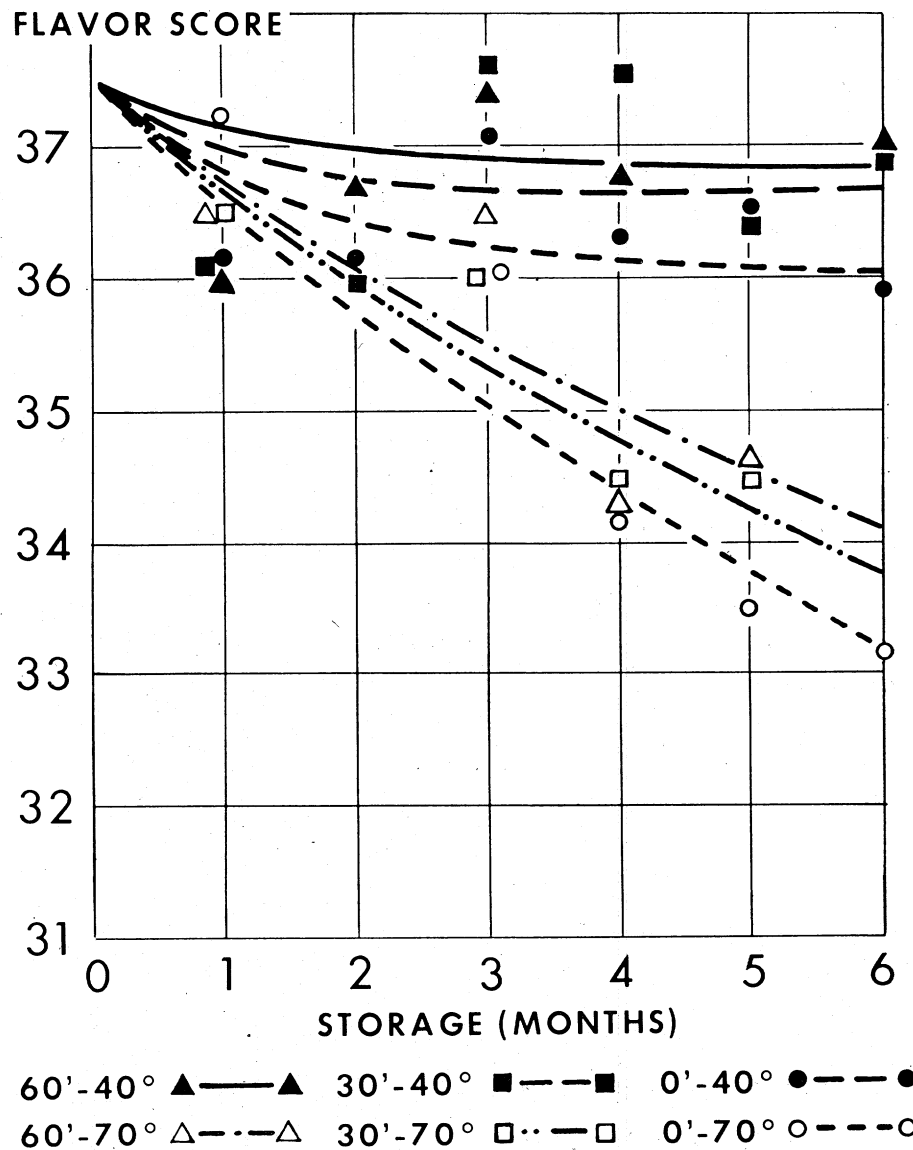


FIG. 2. Effect of deaerating and vacuum-packing concentrated sweetened cream on its flavor score during storage at 40 and 70° F., when the temperature of the concentrate pumped to the unheated vacuum pan was 150° F. and the holding time was 0, 30, and 60 min.

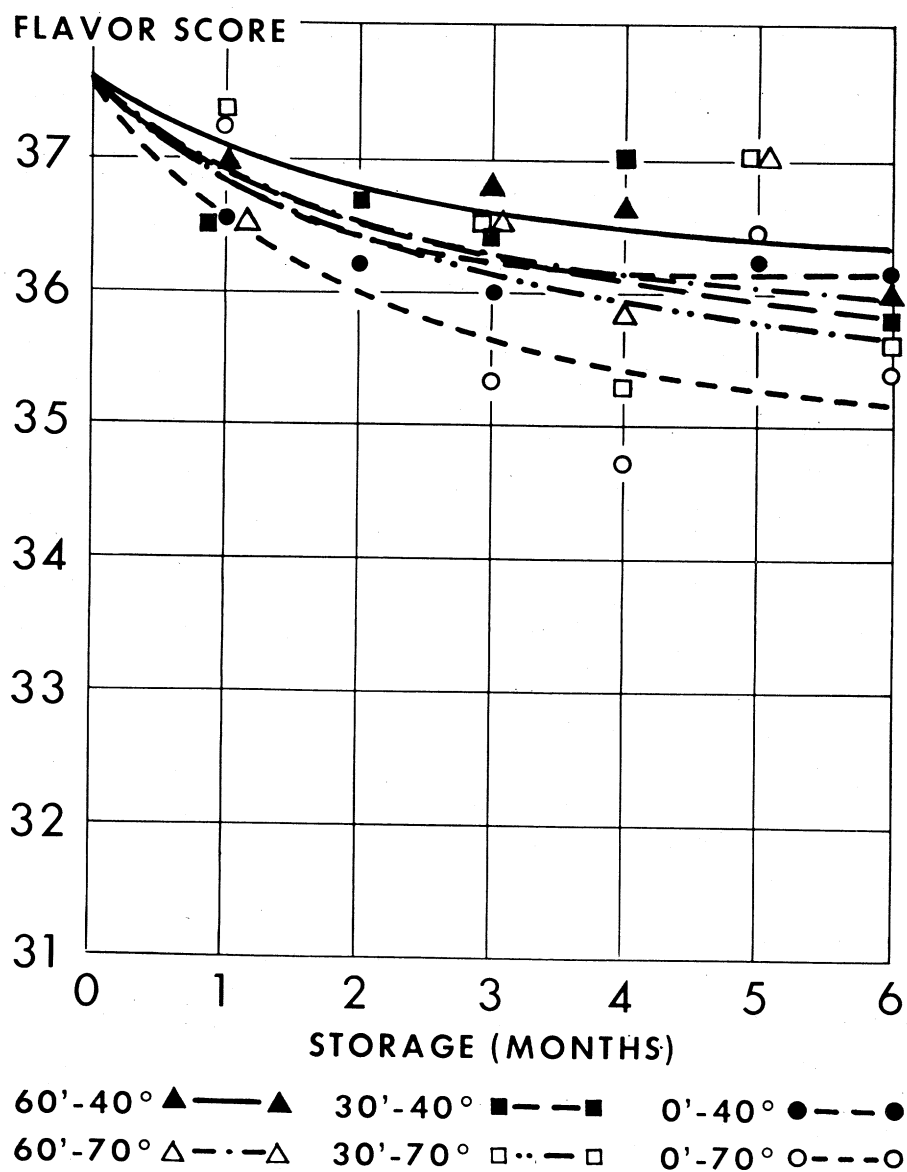


Fig. 3. Effect of deaerating and vacuum-packing concentrated sweetened cream on its flavor score during storage at 40 and 70° F., when the temperature of the concentrate pumped to the unheated vacuum pan was 170° F. and the holding time was 0, 30, and 60 min.

end of each of these three deaerating periods, the product was allowed to flow at atmospheric pressure into small cans to within $\frac{1}{8}$ -in. of the top. Air in the head space of the cans was removed in a sealer under 25 in. of vacuum. During deaeration, the water content of the concentrated sweetened cream was reduced 1 to 3%.

Control samples were cans of the nondeaerated product that were filled and sealed at atmospheric pressure.

Oxygenation. In two experiments, after sucrose and NFDM were added to the cream in the proper proportions, the blend was divided into two parts. One part was used for preparing control samples as described above. Into the other portion at 105-110° F., oxygen was bubbled for 1 hr. Cans were filled with this product, sealed under oxygen, and held 30 min. at 150° F. before being placed in storage at 40 and 70° F.

ANALYSIS

On opening a can, the entire content was mixed thoroughly to obtain uniform distribution of solids, and of the surface portion where flavor deterioration was most likely to occur.

Flavor scoring. For tasting, the concentrated sweetened cream was diluted with an equal volume of distilled water to reduce both its sweetness and viscosity. If the product did not disperse satisfactorily in the water, the mixture was hand-homogenized.

The taste panel consisted of six trained judges, each in an isolated booth. It used the scoring guide illustrated in Table 1, and each member independently recorded his score. The averages of these scores are reported here to the nearest month of tasting. The scoring guide is based partly on the score-card and scoring guide of the American Dairy Science Association for dry milk, but includes flavors not listed on that score-card.

Peroxide analysis. Three methods of recovering fat from the concentrated sweetened cream were tested. Separation by holding samples overnight at 0° F., warming and centrifuging a portion of each was unsatisfactory because of

TABLE 1
Scoring guide for concentrated sweetened cream

Flavor	Slight	Definite	Pronounced
Cooked	40-39	38-37	36-35
Caramel	39-38	37-36	35-34
Scorched	36-34	33-31	30-28
Stale	36-34	33-31	30-28
Utensil	36-34	33-31	30-28
Oily	35-34	33-32	31-30
Proteolytic	35-33	32-30	29-27
Oxidized	35-33	32-30	29-27
Metallic	35-33	32-30	29-27
Musty	34-32	31-29	28-26
Yeasty	34-32	31-29	28-26
Tallowy	32-30	29-26	25-23
Rancid	32-30	29-26	25-23
Fishy	30-28	27-24	23-21
Foreign	25-20	19-10	9-0

variation in the amount of fat obtained. The detergent method of Stine *et al.* (5) gave values impossible to interpret. The procedure described by Pont (3) was found to be satisfactory and was employed for extracting the fat used in determining peroxide values by the method of Hills and Thiel (2). Peroxide values are reported in milliequivalents of oxygen per kilogram of fat. Benzoyl peroxide added to the solvent was 98.1% recovered.

RESULTS AND DISCUSSION

Effect of deaerating conditions. The conditions under which air was removed from the concentrated sweetened cream affected its flavor stability. This is

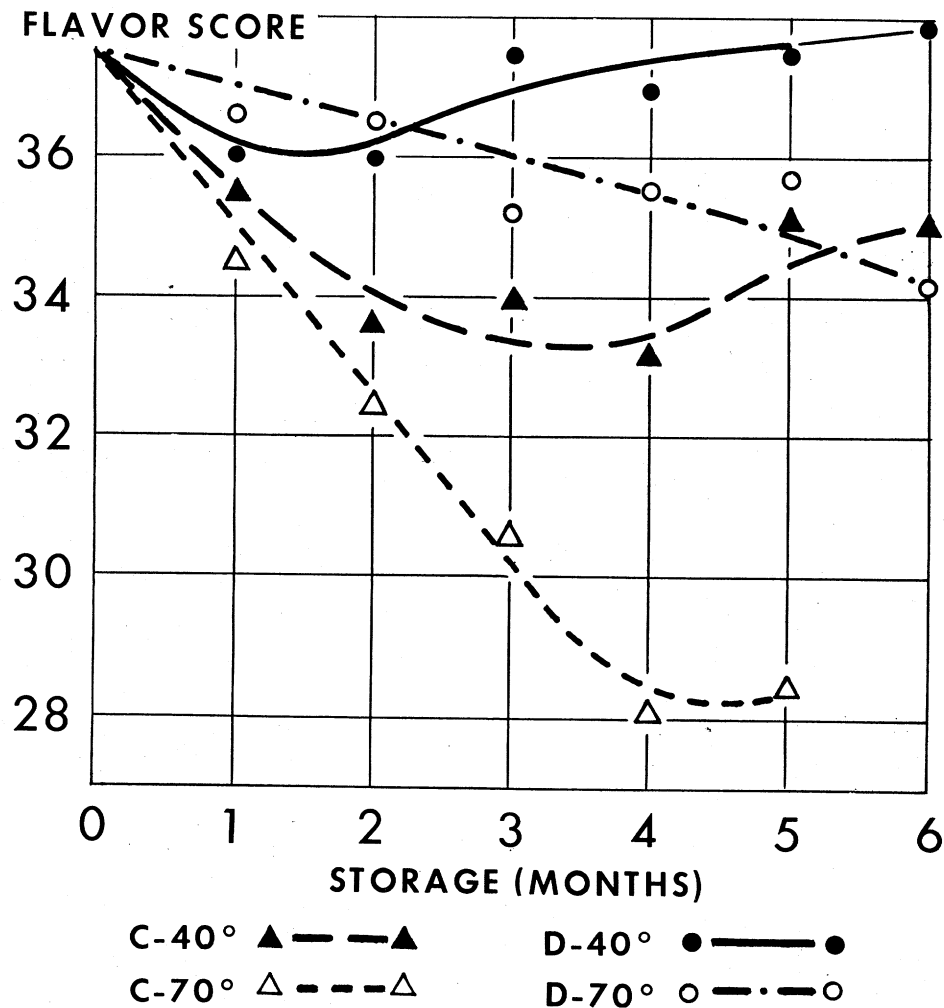


FIG. 4. Effect of deaerating and vacuum-packing concentrated sweetened cream on its flavor score during storage at 40 and 70° F. C = Undeaerated, D = Deaerated and vacuum-packed.

exemplified in Figures 1, 2, and 3. In Figure 1, the temperature of the blend when it was flashed into an unheated vacuum pan was 135°, in Figure 2 it was 150°, and in Figure 3, 170° F. These results are based on flavor score averages of two or more experiments at each of the three pumping temperatures.

When deaeration was initiated at 135° F., and with no additional heating in the vacuum pan, there was a decrease in flavor score of nearly two points at the end of 6 mo., when the product had been held under 29 in. of vacuum for 60 min. and stored at 40° F. On the other hand, when the concentrated sweetened cream was delivered to the vacuum pan at 150° F., only a brief holding period was sufficient to cause the product to have a somewhat better flavor after 6 mo. at 40° F. than that deaerated at 135° F. And when deaeration was initiated at 170° F. and was continued for 60 min., the product retained its flavor as well at 70° as did the comparable samples of Figure 1 that were stored at 40° F. and in spite of the fact, as these figures show, that the flavor of concentrated sweetened cream is much more stable at 40 than at 70° F.

The effect of deaeration is shown further in Figures 4 and 5. The data are based on average scores and peroxide values of two similar experiments in which deaeration consisted of flashing the concentrate into the vacuum chamber at about 150° F. and holding it continuously under a vacuum of 29 in. for 1 hr.

The peroxide values of the nondeaerated (control) samples increased rapidly at both storage temperatures. At 70° F., the flavor scores decreased steadily to 28 and at 40° F. they dropped to 33.5 in 2 mo. and remained between 33 and 35 during the remaining 4 mo.

The peroxide values of deaerated samples stored at 40° F. increased slightly in the first 2 mo., then decreased in the 3 mo. following. At 70° F. there was an irregular and small decrease in peroxide values. The irregularities in these curves may have been due to lack of sensitivity in the method at such low peroxide concentrations.

Control samples stored at 70° F. for 2 mo. had a slight to pronounced oxidized flavor according to five of the six judges. One of the samples stored at 40° F. for 2 mo. had a slight to definite oxidized flavor according to four judges.

The initial flavor score of the deaerated and vacuum-packed samples stored at 70° F. was retained well for 2 mo., but it decreased to 34 during the ensuing 4 mo. At 40° F., the initial score was maintained more than 6 mo., the score being 38 at 7½ mo.

One deaerated sample stored at 40° F. for 4 mo. had a slight oxidized flavor according to three judges, but no such flavor was found at 5 mo. After 5 mo. one deaerated 70° sample was criticized by one judge for a slight, and by a second for a definite, oxidized flavor.

Oxygenation. Bubbling oxygen into concentrated sweetened cream for 1 hr. at 105-110° F. resulted in a marked increase in the peroxide values and decrease in flavor scores during storage for 3 mo. In 1 mo., oxygenated samples stored at 70° F. had a peroxide value of 1.58, whereas that of the control was 0.56. After 2 mo., the peroxide values were 3.85 and 0.98, respectively. The 40° F. samples had correspondingly similar but lower peroxide values; within 2 mo.

PEROXIDE VALUE (Milliequivalent oxygen/kg. fat)

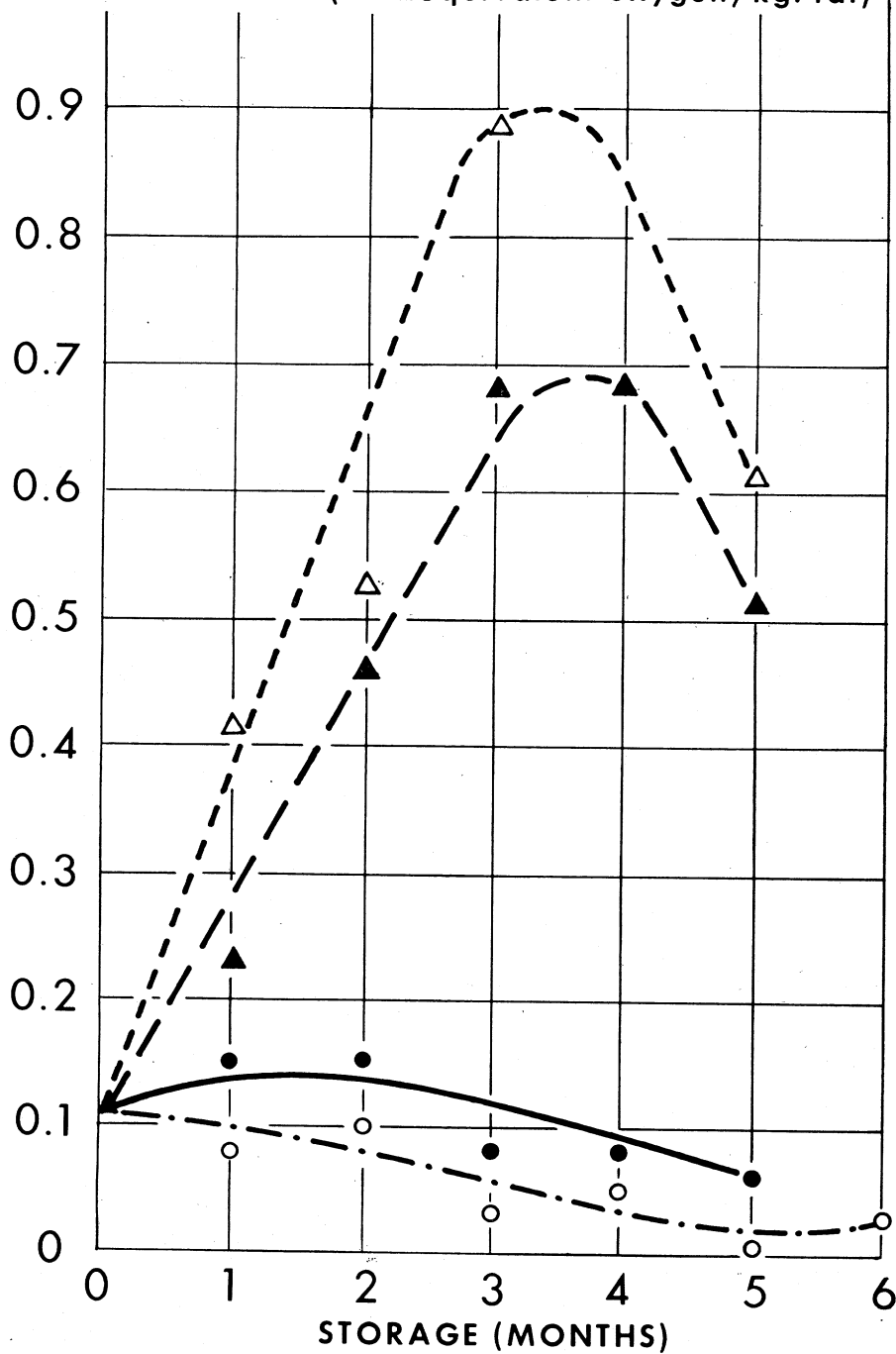


FIG. 5. Effect of deaerating and vacuum-packing concentrated sweetened cream on its peroxide value during storage at 40 and 70° F. C = Undeaerated, D = Deaerated and vacuum-packed.

the peroxide value of the oxygenated sample was 1.49 and the control was 0.64.

The oxygenated samples stored at 70° F. developed an objectionable flavor within 1 mo.; at 40° F. they maintained their flavor for only 1 mo., then their flavor deteriorated rapidly.

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